Problem 2.1 Introducing Addition of Integers

Use chip models or number line models.

A. **1.** Find the sums in each group.

2. Describe what the examples in each group have in common.

3. Use your answer to part (2) to write two problems for each group.

4. Describe an algorithm for adding integers in each group.

Group 1
$^{+}2 + {}^{+}8$
$^{-}3 + {}^{-}8$
$^{+}20 + {}^{+}25$
$^{-}24 + {}^{-}12$

Group 2
$^{+}8 + {}^{-}12$
$^{-}3 + {}^{+}2$
$^{+}14 + {}^{-}23$
$^{-}11 + {}^{+}13$

B. Write each number as a sum of integers in three different ways.

1. $^{-}5$ **2.** $^{+}15$ **3.** 0

4. Check to see whether your strategy for addition of integers works on these rational number problems.

a. $^{-}1 + {}^{+}9$ **b.** $^{-}1\frac{1}{2} + {}^{-}\frac{3}{4}$ **c.** $^{+}1\frac{1}{2} + {}^{-}2\frac{3}{4}$

C. Write a story to match each number sentence. Find the solutions.

1. $^{+}50 + {}^{-}65 = \square$ **2.** $^{-}15 + \square = {}^{-}25$ **3.** $^{-}300 + {}^{-}250 = \square$

D. Find both sums in parts (1) and (2). What do you notice?

1. $^{+}12 + {}^{-}35$ $\quad {}^{-}35 + {}^{+}12$ **2.** $^{-}7\frac{2}{3} + {}^{-}1\frac{1}{6}$ $\quad {}^{-}1\frac{1}{6} + {}^{-}7\frac{2}{3}$

3. The property of rational numbers that you have observed is called the **Commutative Property** of addition. What do you think the Commutative Property says about addition of rational numbers?

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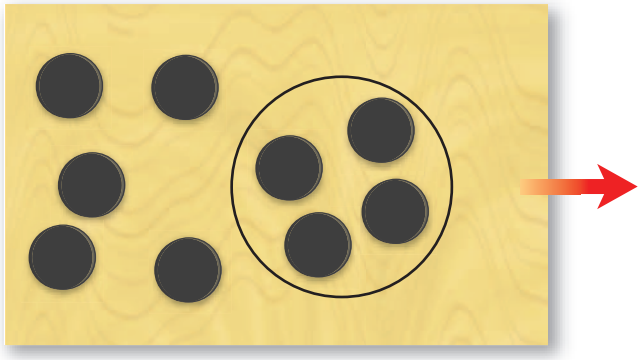
2.2 Introducing Subtraction of Integers

In some subtraction problems, you *take away* objects from a set, as in this first example:

Example 1 Kim had 9 CDs. She sold 4 CDs at a yard sale. She now has only $9 - 4 = 5$ of those CDs left.

You can represent this situation on a chip board.

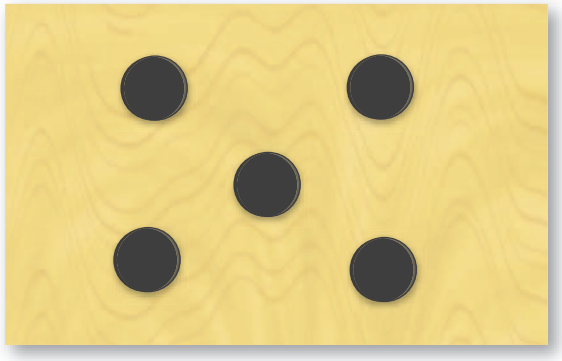
9 – 4 = 5



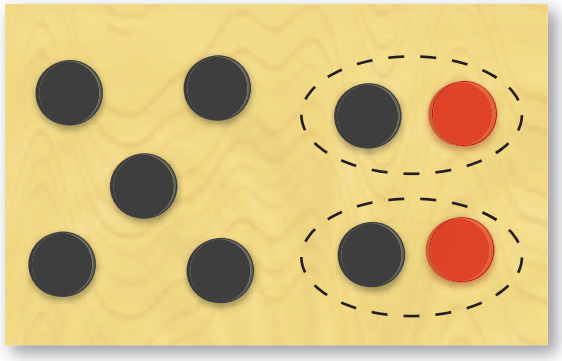
Here is another example.

Example 2 Otis earned \$5 babysitting. He owes Latoya \$7. He pays her the \$5. Represent this integer subtraction on a chip board.

To subtract 7 from 5 ($^{+}5 - {}^{+}7$), start by showing $^{+}5$ as black chips.



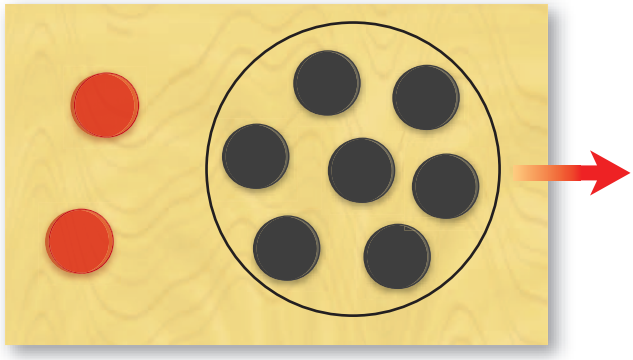
You can't take away $^{+}7$ because there aren't seven black chips to remove. Since adding both a red chip and a black chip does not change the value of the board, add two black chips and two red chips. The value of the board stays the same, but now there are 7 black chips to take away.



5 – 7 = $^{-}$2

What is left on the board when you take away the 7 black chips?

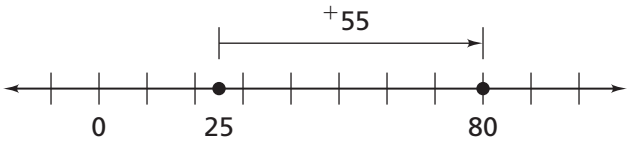
The changes on the board can be represented by $(^{-}2 + 2) + 5 - 7 = {}^{-}2$. Otis now has $^{-}$\$2. He still owes Latoya \$2.



In a third example of a subtraction problem, you find the *difference* between two numbers.

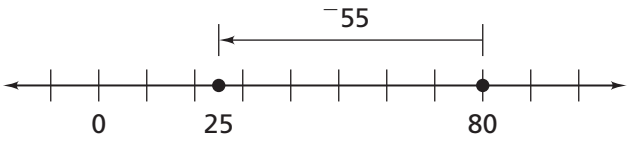
Example 3 The Arroyo family just passed mile 25 on the highway. They need to get to the exit at mile 80. How many more miles do they have to drive?

You can use a number line to show differences.



The arrow on the number line points in the direction of travel. The Arroyos are traveling in a positive direction from small values to greater values. They still have to travel $80 - 25 = 55$ miles.

If the Arroyos drive back from mile 80 to mile 25, they still have to travel 55 miles. This time, however, they travel in the opposite direction. The number sentence $25 - 80 = {}^{-}55$ represents this situation.



Now, the arrow points to the left and has a label of $^{-}55$. The distance is 55, but the direction is negative.

Sometimes you only want the distance and not direction. You can show distance by putting vertical bars around the given number. This is called absolute value. The **absolute value** of a number is its distance from 0 on the number line.

$$|{}^{-}55| = 55 \qquad |{}^{+}55| = 55$$

You say "the absolute value of $^{-}55$ is 55" and "the absolute value of $^{+}55$ is 55."

When you write a number and a sign (or an implied sign for +) on an arrow above a number line, you are indicating both distance and direction.

In a problem that involves the amount of money you have and the amount that you owe, is the sign (direction) important?

Problem 2.2 Introducing Subtraction of Integers

Use chip models or number line models.

A. 1. Find the differences in each group below.

Group 1	Group 2
$^{+}12 - {}^{+}8$	$^{+}12 - {}^{-}8$
$^{-}5 - {}^{-}7$	$^{-}5 - {}^{+}7$
$^{-}4 - {}^{-}2$	$^{-}4 - {}^{+}2$
$^{+}2 - {}^{+}4$	$^{+}2 - {}^{-}4$

2. Describe what the examples in each group have in common.

3. Use your answer to part (2) to write two problems for each group.

4. Describe an algorithm for subtracting integers in each group.

5. Check to see whether your strategy for subtraction of integers works on these rational number problems:

a. $^{-}1 - {}^{+}3$ **b.** $^{-}1 - {}^{+}\frac{3}{4}$

c. $^{-}1\frac{1}{2} - {}^{-}2$ **d.** $^{-}1\frac{1}{2} - {}^{-}\frac{3}{4}$

B. Write each number as a difference of integers in three different ways.

1. $^{-}5$ **2.** $^{+}15$

3. 0 **4.** $^{-}3.5$

C. For parts (1)–(4), decide whether the expressions are equal.

1. $^{-}2 - {}^{+}3 \stackrel{?}{=} {}^{+}3 - {}^{-}2$ **2.** $^{+}12 - {}^{-}4 \stackrel{?}{=} {}^{-}4 - {}^{+}12$

3. $^{-}15 - {}^{-}20 \stackrel{?}{=} {}^{-}20 - {}^{-}15$ **4.** $^{+}45 - {}^{+}21 \stackrel{?}{=} {}^{+}21 - {}^{+}45$

5. Do you think there is a Commutative Property of subtraction?

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